Computer Engineering Department
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LAB03: Image Enhancement in the Spatial Domain (part3)

Objectives

The goals of this lab, you will be able to:

1. Explain the different types of sharpening spatial filters.
2. Write a user-defined function in MATLAB for finding the edges of objects within an image, including first-order and second-order derivative filters.
3. Write the user-defined function in MATLAB to sharpen a blurry image by subtracting the Laplacian filtered image from the blurry image**.**

Introduction

Sharpening spatial filters aim to find the edges of objects in an image, or enhance the fine detail within the image. There are two main ways to perform edge detection, including first-order derivative filter (referred to gradient method) and second-order derivative filter (referred to Laplacian method). The gradient method looks for the maximum and minimum in the first-order derivative of the image to find the edges (i.e. Roberts, Prewitt, and Sobel mask filters). For the Laplacian, the method detects the edges by searching for zero-crossings in the second-order derivative of the image (i.e. Laplacian mask filter using a negative peak and Laplacian mask filter using a positive peak).

We summarize that first-order derivative filter detects perfectly the thick edges while second-order derivative filter detects extremely the thin edges. Therefore, we can expect much more for enhancing the fine detail in the image with second-order derivative filter than first-order derivative filter.

Exercises

Note that you should create your own function in MATLAB as MATLAB User-defined function. It means that you cannot call MATLAB built-in function, which generates output in the same manner as your own function. You can use the images provided in the folder \Google Drive\EGCI486_57-3\LABs\LAB03_Part3 for your exercises.

1) Image enhancement in spatial domain using first-order derivative filter (Gradient method)

1.1 Write a user-defined function in MATLAB for finding the edges of objects within an image with the gradient method using the Prewitt mask filters. Take the following function name: Mygrad.m. Using this program on the image "aaa256.jpg" should give you result as shown in Figure 1.

- 3×3 Prewitt mask filters

-1	-1	-1
0	0	0
1	1	1

H_R

-1	0	1
-1	0	1
-1	0	1

H_C

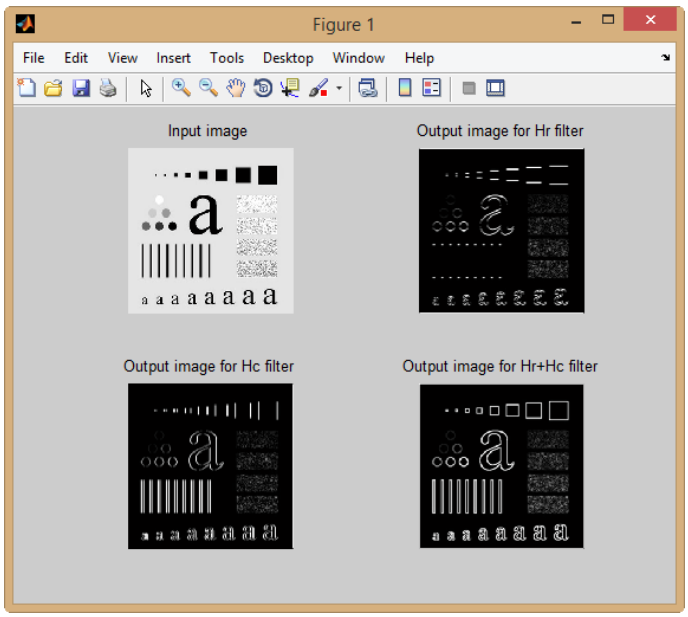

Figure 1: The result image of applying two 3×3 Prewitt mask filters on the input image.

2) Image enhancement in spatial domain using second-order derivative filter (Laplacian method)

2.1 Write a user-defined function in MATLAB for finding the edges of objects within an image with the Laplacian method using the Laplacian mask filter. Take the following function name: MyLaplaNeg.m. When this program is used with the image "aaa256.jpg" result as shown in Figure 2.

- 3×3 Laplacian mask filter (Laplacian mask filter invariant to 90˚ rotations)

0	1	0
1	-4	1
0	1	0

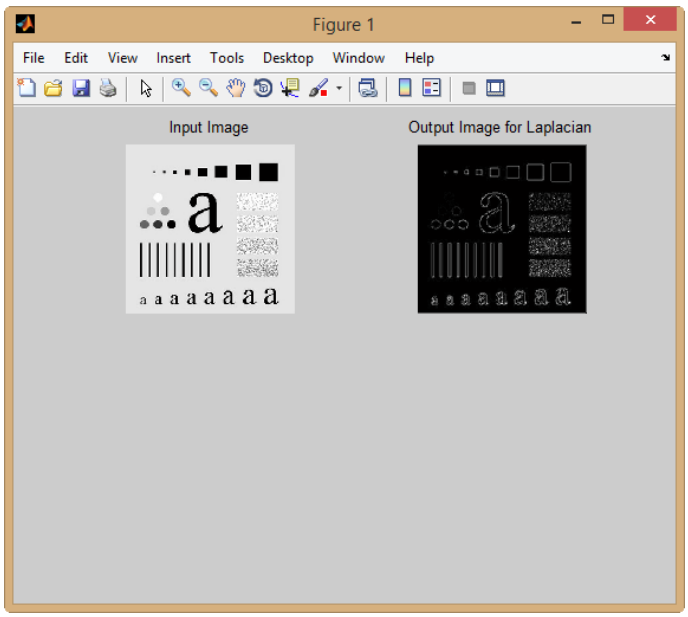

Figure 2: The result image of applying the 3×3 Laplacian mask filter on the input image.

3) Laplacian image enhancement

3.1 Write a user-defined function in MATLAB to sharpen a blurry image. Firstly, you should employ the Laplacian mask filter on the blurry image to obtain Laplacian filtered image. You then restore the gray tones lost simply by subtracting the Laplacian filtered image from the blurry image. Note that we have used the subtraction in the enhancement process, because the center coefficient of the Laplacian mask filter was negative. Take the following function name: EnhanLaplaNeg.m. Using this program on the image "blurry_moon.tif" should give you result as shown in Figure 3.

- 3×3 Laplacian mask filter (Laplacian mask filter invariant to 45˚ rotations)

1	1	1
1	-8	1
1	1	1

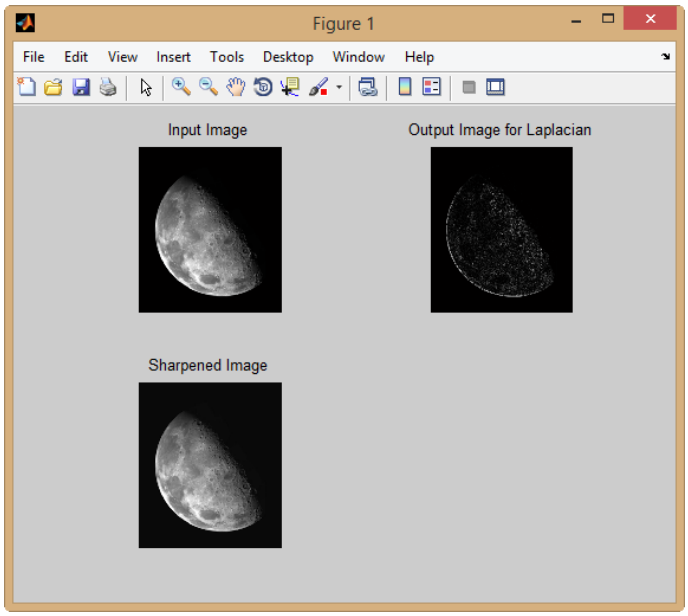

Figure 3: The sharper image obtained by subtracting the Laplacian filtered image from the blurry image.